

**Patent claims**

1. A comminution machine for all kinds of material, for example waste, such as domestic waste, bulky waste  
5 or wood, in particular organic waste or bulky waste, such as refrigerators, tires, furniture, carpets, mattresses, tree stumps, demolition timber or similar materials, which comprises
- a receiving element for the material (5), provided  
10 in a housing (1),
  - at least one shaft (2), mounted in the housing (1) and capable of being driven in both directions, on which comminution tools (3) are arranged,
  - rigid cutting tools (4) which are fitted in the  
15 housing, whose cutting edges (4.1) in the extension just to do not intersect the axis of the shaft (2) or a region around the axis, against which rigid cutting tools (4) the comminution tools of the shaft (2) comminute the material (5)  
20 put in,
- in interplay between the comminution tools (3) of the shaft (2) with the rigid cutting tools (4), the material (5) being taken in a differentiated  
25 manner, being conveyed and, fixed against the rigid cutting tools (4), being comminuted with specifically low forces, characterized in that
- a) the comminution tools (3), seen respectively in  
30 a direction of rotation of the shaft (2) and in their cross section, have at least two cutting regions (3.1, 3.2), of which at least an inner cutting region (3.1) is able to take and comminute more material (5) to be comminuted  
35 and has a relatively short lever arm for this purpose, and also at least one outer cutting

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- region (3.2) is able to take and comminute less material (5) to be comminuted and has a relatively long lever arm for this purpose, the contours (3.3) of both cutting regions (3.1, 3.2) forming a circular arc about the axis of the shaft (2) in the direction of the axis of the shaft (2),
- b) the rigid cutting tools (4) have a number of teeth (4.2) arranged in a manner of a saw and thus two flanks (4.3) of the teeth (4.2) at an angle to each other interact with one of the cutting regions (3.1, 3.2) in a cutting manner,
- c) in each starting effective cutting position, a tip of the comminution tools (3), forming a first transverse cutter (3.4), is oriented toward a tip of a tooth (4.2) of the rigid cutting tools (4), forming a second transverse cutter (4.4), so as to be offset in parallel and cutting past, as a result of which the, besides the cutting forces produced between the cutting regions (3.1, 3.2) of the comminution tools (3) and the cutting edges (4.1) of the rigid cutting tools (4), an additional breaking edge, also arranged parallel to the axis of the shaft (2), with a parallel offset notching action on the material (5) and acting specifically highly is obtained, and
- d) the material (5) is subjected to an active and additional comminution process with the aggressive participation of the teeth (4.2) of the rigid cutting tools (4).
2. The comminution machine as claimed in claim 1, characterized in that the comminution tools (3) are offset in relation to one another in their angular position in the axial direction on the shaft (2).

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3. The comminution machine as claimed in claim 1 or 2, characterized in that the comminution tools (3) are arranged with a different radial spacing from the axis of the shaft (2).
4. The comminution machine as claimed in one of claims 1 to 3, characterized in that the teeth (4.2) of the rigid cutting tools (4) in their cutting contour (4.5) extend offset parallel in the axial direction as a slab and, in each starting cutting position, in each case one of the transverse cutters (3.4) is oriented toward one of the second transverse cutters (4.4) in each case, cutting with a parallel offset.
5. The comminution machine as claimed in one of claims 1 to 4, characterized in that the shaft (2) has disks (2.1) on which the comminution tools (3) are arranged or formed, which intermesh between the rigid cutting tools (4) extending at intervals on the slab and act against these in a cutting manner.
6. The comminution machine as claimed in one of claims 1 to 5, characterized in that the shaft (2) has journals (2.2) which are detachably joined to the shaft (2).
7. The comminution machine as claimed in one of claims 1 to 6, characterized in that the journals (2.2) form a bearing region.
8. The comminution machine as claimed in one of claims 1 to 7, characterized in that the joint between journal (2.2) and shaft (2) is made by means of flanges (2.3).

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9. The comminution machine as claimed in one of claims 1 to 8, characterized in that housing (1) is formed with a double wall (1.1) at the ends and, in the interspace therein, a disk seal (2.4) connected to the shaft (2) is provided and a type of labyrinth seal is formed as a result.
10. The comminution machine as claimed in one of claims 1 to 9, characterized in that the disk seal (2.4) is formed by the flanges (2.3).
11. The comminution machine as claimed in one of claims 1 to 10, characterized in that cutting contours (4.5) of the rigid cutting tools (4) are reinforced by wearing elements (4.6).
12. The comminution machine as claimed in one of claims 1 to 11, characterized in that means for optimizing the comminution machine are also provided, with which the gradient of a parameter of the comminution process or of the comminution machine is registered and used as a reference variable for control of the comminution machine.